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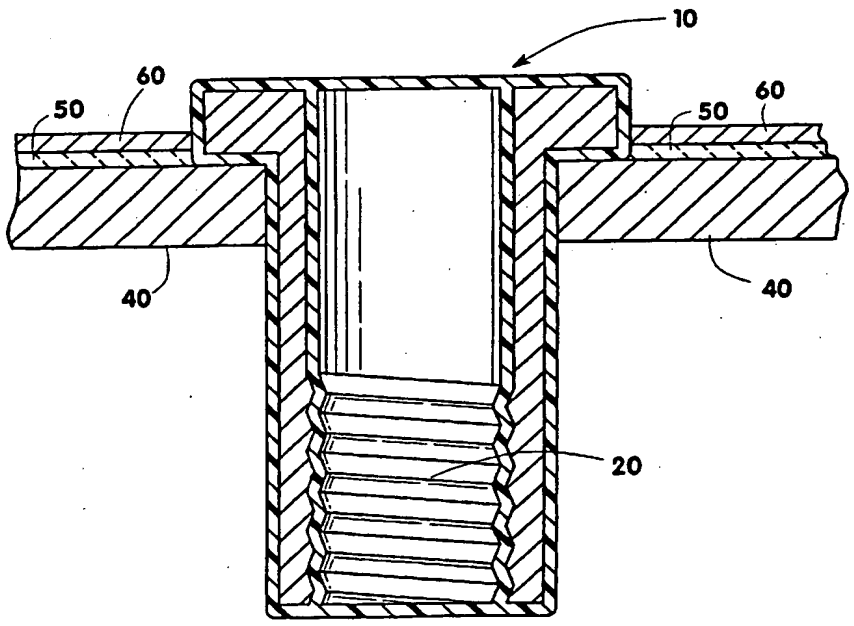
(54) Title: METHOD OF MASKING COATINGS AND RESULTANT OBJECT



(57) Abstract: A method for masking electrodeposited coatings on an article surface utilizing a parylene film (30) which insulates the article surface such that charged particles do not adhere to the surface of the parylene film. Preferably, the parylene film having a thickness of up to about 1 mil is formed on a fastener (10) used in automotive assemblies such that after electrocoating of the automobile, subsequent parts may be attached via the fastener. The parylene film effectively prevents adhesion of the electrocoat on the fastener such that subsequent manual re-tapping of the fastener thread is avoided.

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METHOD OF MASKING COATINGS AND RESULTANT OBJECT

DESCRIPTION

Technical Field

This invention relates to a method of preventing adhesion of coatings on an object surface and a resultant object of the method, and more particularly to preventing adhesion of electrodeposited paint on fasteners used in the automotive industry.

Background Art

In the automotive industry, electrocoating or electrodeposition is a common and advantageous method of providing a superior paint finish. Electrocoating provides a uniform finish quality, is easily incorporated into an automated manufacturing process, and is economically efficient. For economies of scale and automated productivity, electrocoat systems finish vast numbers and varieties of parts with little direct labor and at high speeds. Approximately 98% of all automobiles produced in the world use an electrocoat primer.

Prior to the electrocoating, the majority of the automobile has been assembled while subsequent parts which do not require painting, e.g., roof racks, are attached thereafter. Fasteners, e.g., rivets, nuts, bolts, used to connect the subsequent parts are already attached to the automobile so that the electrocoating will provide a smooth continuous coating at the interface between the fastener and the sheet metal of the automobile. However, upon applying the electrocoat and curing the paint finish, any threads on the fasteners usually become coated as well and must be manually re-tapped prior to attaching the subsequent parts. The manual re-tapping disrupts the automated assembly increasing costs and manufacturing time. Thus, it is desirable to provide a method of preventing adhesion of the paint on the fasteners such that the manual re-tapping is avoided.

Bearing in mind the problems and deficiencies of the prior art, it is therefore an object of the present invention to provide a method of preventing adhesion of electro-deposited paint on fasteners used in the automotive industry.

It is another object of the present invention to provide a method of preventing adhesion of electrodeposited paint on parts used in automotive assembly to reduce manual re-work involved in the automotive assembly process.

A further object of the invention is to provide a fastener for use in the automotive assembly process having a coating which effectively prevents adhesion of electrodeposited paint onto the fastener surface.

Still other objects and advantages of the invention will in part be obvious and will in part be apparent from the specification.

Disclosure of Invention

The above and other objects, which will be apparent to those skilled in the art, are provided in the present invention which relates in a first aspect to a method of masking coatings on an object comprising the steps of: cleaning the object; forming a parylene film on a surface of the object to form a coated surface; and effectively preventing adhesion of an electrocoating on the coated surface of the object. Preferably, the step of cleaning the object comprises cleaning the object with an alkaline bath, an acid bath and/or a charged bath to insure that the object surface is free from contaminates and soil. The object may be having a bare metal surface, with or without a coating, or plated with metal prior to the step of forming a parylene film on a surface of the object. If the fastener is plated with a metal, it is preferable to treat the fastener with a chromate conversion solution after metal plating. Preferably, the step of forming a parylene film on a surface of the object to form a coated surface comprises forming a parylene film of up to about 1 mil.

In a second aspect, the present invention is directed to a method of masking a fastener in an automotive assembly comprising the steps of: providing a fastener; cleaning the fastener; forming a parylene film on a surface of the fastener; attaching the fastener to the automotive assembly; and electrocoating the automotive assembly including the fastener wherein the surface of the fastener having the parylene film is effectively masked from paint adhesion.

In a third aspect, the present invention is directed to a method of masking coatings comprising the steps of: providing an article having a parylene film thereon; attaching the article having a parylene film to a surface to be electrocoated; applying a coating composition simultaneously to both the surface and the article having a parylene film, the coating composition effectively adhering to the surface while the coating composition is effectively prevented from adhering to the article having a parylene film. Preferably, the step of applying a coating composition comprises electrodeposition of paint particles.

In a fourth aspect, the present invention is directed to a method of attaching automotive assemblies comprising the steps of: providing a fastener having internal threads; coating the fastener with a parylene film; inserting the fastener into an aperture of a first automotive assembly utilizing the external threads of the fastener; electrocoating the automotive assembly and the fastener inserted therein with paint such that a continuous coating of paint is formed at the interface between the fastener and the automotive assembly; preventing adhesion of the paint onto the exposed surfaces of the fastener having the parylene film; and attaching a second automotive assembly to the first automotive assembly utilizing the fastener wherein the internal threads of the fastener are substantially paint-free. The method of this aspect may further include, after the step of preventing adhesion of the paint coating onto the parylene coated surfaces of the fastener, the step of phosphating metal surfaces of the automotive assembly, and the step of applying a primer to the phosphated metal surfaces.

In a fifth aspect, the present invention is directed to a method of painting an automotive assembly comprising the steps of: providing an automotive assembly including fasteners, the fastener having a parylene film of up to about 1 mil formed thereon; electrocoating the automotive assembly with a paint finish; effectively preventing adhesion of the paint finish on the parylene film of the fastener such that subsequent contact with a part to be attached is unobstructed by excess paint.

In a sixth aspect, the present invention is directed to a fastener having a threaded portion; and a parylene film formed on a surface of the fastener wherein

subsequent coatings are effectively masked from adhering to the fastener surface. Preferably, the fastener may further include a metal plating selected from the group consisting of zinc, iron, nickel, copper, cadmium and alloys thereof; and a coating of a corrosion protection agent. Preferably, the parylene film effectively masks subsequent electrodeposited coatings on the fastener surface such that re-tapping of the threaded portion is not required prior to use. Most preferably, the parylene film has a thickness of up to about 1 mil.

Brief Description of the Drawings

The features of the invention believed to be novel and the elements characteristic of the invention are set forth with particularity in the appended claims. The figures are for illustration purposes only and are not drawn to scale. the invention itself, however, both as to organization and method of operation, may best be understood by reference to the detailed description which follows taken in conjunction with the accompanying drawings in which:

Fig. 1 is a cross-sectional view of a preferred fastener of the present invention, a riv-nut having an internal threaded portion as it is inserted in an automotive assembly.

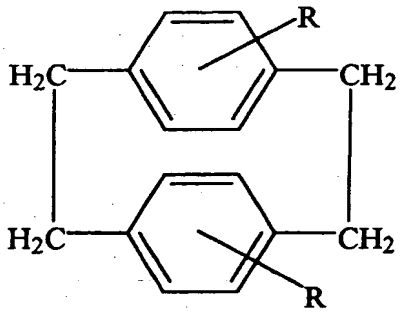
Mode(s) for Carrying Out the Invention

In describing the preferred embodiment of the present invention, reference will be made herein to Fig. 1 of the drawings in which like numerals refer to like features of the invention. Features of the invention are not necessarily shown to scale in the drawings. The features of the invention believed to be novel and the elements characteristic of the invention are set forth with particularity in the appended claims. The present invention provides a solution to a long-felt need in the automotive industry to mask coatings on an article subject to electrocoating, its technology may also be applied in other areas. A method of masking coatings, particularly paint finishes used in the automotive industry, using a parylene film, is disclosed herein. The present invention also includes a resultant object such as a

fastener used to assemble automotive parts subject to the painting process after assembly wherein the parylene coating effectively prevents adhesion of the electrodeposited paint finishes such that manual re-tapping of the fastener's threads are not required prior to attachment of additional automotive parts via the fastener.

Although any object may be coated with a parylene film to prevent adhesion of electrodeposited coatings, a fastener is used as an example in the following discussion. A preferred fastener of the present invention may have a threaded portion comprising either external and/or internal threads, and a coating on all surfaces of a parylene film preferably having a thickness of up to about 1 mil. Exemplary fasteners include screws, bolts, nuts, rivets, and a combination of a rivet and nut commonly referred to as riv-nuts. The fasteners are generally made of steel or other materials of similar strength including copper, brass or titanium and is of the type to be crimped, welded or threaded to attach two parts together.

The present invention effectively prevents subsequent paint finishes from adhering to the fastener by coating the fastener with a parylene film. The parylene film is derived from a commercially available dimer employed to produce a poly-*para*-xylylene film using organic vapor deposition techniques. Preferably, the dimer has the following chemical structure:



wherein substituent R may be, for example, allyl, aryl, alkyl, cyano, carboxyl, alkoxyl, hydroxy, hydrogen, halogen, amino and combinations thereof.

The fastener is preferably prepared by thoroughly cleaning the fastener surface to remove surface soil and oils. The fastener is soaked in an alkaline cleaning bath such as Enprep™ 198 available from Enthone Inc., of West Haven,

CT. The fastener is soaked in the Enprep™ 198 at a concentration of about 8 to about 12 opg (ounces per gallon) for about 3 to 7 minutes, preferably about 5 minutes, at about 175° to 185°F, preferably about 180°F. After a water rinse, preferably with deionized water, the fastener may be placed in a second alkaline bath using a caustic soda such as Enprep™ 576-E, also available from Enthone Inc., for further cleaning. The fastener is placed in the caustic soda bath at a concentration of about 10 to about 12 opg for about 1 to 5 minutes, preferably about 3 minutes, at about 175° to 185°F, preferably about 180°F, wherein a potential of about 6 to 12 Volts is applied to the fastener. The charged caustic soda bath removes any particles that may still exist on the fastener surface. It is important to note that the fastener surface should be as free of contaminating particles and soil as possible.

After another water rinse, any remaining alkaline residues on the fastener surface are neutralized with an acid dip such as Aricid B™ available from Heatbath, Inc. of Springfield, MA at a concentration of about 8 to about 30 opg. The fastener is subjected to the inhibited acid dip for about 30 seconds to about 2 minutes at about 70° to about 90°F to ensure that the alkaline cleaners have been sufficiently neutralized followed by yet another water rinse.

The fastener may be have the parylene film formed directly on its bare surface at this point. Optionally, it may be plated with a metal such as zinc, nickel, iron, copper, cadmium or alloys thereof such as zinc iron. It is preferable to plate the fastener in an acidic zinc plating bath having a pH of about 5.0 to about 5.6 comprising about 35 to 45 g/l zinc metal, about 115 to 135 g/l potassium chloride, and about 15 to 20 g/l boric acid at a temperature of about 70° to 90°F. Alternatively, the fastener may be plated with an alkaline zinc iron bath comprising about 9 to 12 g/l zinc metal, about 180 to 250 mg/l iron metal, 125 g/l sodium hydroxide at ambient temperature.

The fastener may also be treated with a corrosion protection agent to protect the metal plating. Preferably, a chromate conversion coating is used since it is known to be effective in protecting zinc and other metals during storage and is

applied by a simple immersion process. Preferred conditions for the chromate conversion coating utilize a conversion bath comprising about 2 to 3 vol.% Enthone™ 7701 at a temperature of about 70° to 90°F for about 30 seconds to about 2 minutes. The chromate conversion coating may also be applied directly to the bare metal surface of the fastener without the metal plating.

Once the fastener has a chromate conversion coating, it is given a parylene coating having a preferred thickness of up to about 1 mil. Parylene coating processes and apparatus are known in the art and are disclosed in U.S. Patent No. 5,908,506 which is hereby incorporated by reference in its entirety. The parylene provides a parylene film insulating the fastener surfaces such that during electrocoating of the paint finish, the charged paint particles do not adhere to the parylene film.

Thus, a preferred masked fastener of the present invention has a parylene film of up to about 1 mil with optional metal plating having a thickness of about 0.0002 to about 0.0004 inches and chromate conversion coating. The metal plating and chromate conversion coating is formed on the fastener surface prior to formation of the parylene film. In Fig. 1 is illustrated a cross-section of a preferred masked fastener 10, a riv-nut, of the present invention having a threaded portion 20 and a parylene film 30.

The masked fastener of the present invention when used in the context of the automotive industry is typically used as a connection means for attaching parts or assemblies of the automobile. The riv-nut fastener, for example, is secured in an opening in an unpainted sheet metal panel of an automobile assembly, such as a roof panel 40. The entire automobile assembly having the fasteners already inserted therein awaiting attachment of subsequent assemblies is then subjected to the electrocoating paint process. A pretreatment comprises of cleaning and applying phosphating coating 50 on the metal surface of the assembly. During the electrocoating process, the assembly is immersed in a water-based electrocoat bath having paint particles suspended therein. A DC charge is applied to the assembly and the paint particles are drawn to the metal to form an even continuous film over

every surface, into every crevice and corner until the coating 60 reaches a desired thickness determined by the charge. At the desired thickness, the paint coating 60 insulates the assembly so that the attraction between the charged paint particles and the assembly stops. The parylene coated surfaces 30 of the assembly are insulated thereby preventing the adhesion of the charged paint particles. Once the desired coating thickness is achieved, the assembly is removed from the electrocoat bath, excess paint is removed and the painted finish is cured. Additional coatings or a topcoat may also be applied thereafter. Attachment of subsequent assemblies to the painted automobile do not require manual re-tapping of the fastener threads 20 since the paint has not adhered to the parylene film. Thus, costly manufacturing time in manual re-work is avoided.

The present invention provides a method for masking electrodeposited coatings on an article surface utilizing a parylene film which insulates the article surface such that charged particles do not adhere to the surface having the parylene film. Tight thread tolerances in the automotive, electronic and telecommunication fields are easily met with the use of the parylene film on a fastener of the present invention. Preferably, a parylene film formed on a fastener used to attach automotive assemblies to the automobile after electrocoating effectively prevents adhesion of the electrocoat on the fastener such that subsequent manual re-tapping of the fastener threads is avoided.

While the present invention has been particularly described, in conjunction with a specific preferred embodiment, it is evident that many alternatives, modifications and variations will be apparent to those skilled in the art in light of the foregoing description. It is therefore contemplated that the appended claims will embrace any such alternatives, modifications and variations as falling within the true scope and spirit of the present invention.

Thus, having described the invention, what is claimed is:

Claims

1. A method of masking coatings on an object comprising the steps of:
cleaning the object; and
forming a parylene film on a surface of the object to form a coated surface; and
effectively preventing adhesion of an electrocoating on the coated surface of the object.

2. The method of claim 1 wherein the step of cleaning the object comprises cleaning the object with an alkaline bath and an acid bath.

3. The method of claim 1 wherein the step of cleaning the object comprises cleaning the object with an acid bath.

4. The method of claim 1 wherein the step of cleaning the object comprises cleaning the object with a charged bath.

5. The method of claim 1 further including the step of metal plating the object prior to the step of forming a parylene film on a surface of the object.

6. The method of claim 1 wherein the step of forming a parylene film on a surface of the object to form a coated surface comprises forming a parylene film of up to about 1 mil.

7. The method of claim 1 further including the step of treating the object with a corrosion protection agent comprising a chromate conversion solution.

8. A method of masking a fastener in an automotive assembly comprising the steps of:
providing a fastener;

cleaning said fastener;

forming a parylene film on a surface of said fastener;

attaching said fastener to the automotive assembly; and

electrocoating the automotive assembly including said fastener wherein the surface of said fastener having the parylene film is effectively masked from paint adhesion.

9. The method of claim 8 wherein the step of cleaning said fastener comprises soaking said fastener in an alkaline bath.

10. The method of claim 8 wherein the step of cleaning said fastener further comprises soaking said fastener in a charged bath.

11. The method of claim 8 further including the steps of plating said fastener with a metal selected from the group consisting of zinc, nickel, copper, cadmium, iron and alloys thereof and coating said fastener with a corrosion protection agent.

12. The method of claim 8 wherein the step of forming a parylene film on a surface of said fastener comprises forming a parylene film on a surface of said fastener having a thickness of up to about 1 mil.

13. A method of masking coatings comprising the steps of:

providing an article having a parylene film thereon;

attaching the article having a parylene film to a surface to be electrocoated;

applying a coating composition simultaneously to both the surface and the article having a parylene film, the coating composition effectively adhering to the surface while the coating composition is effectively prevented from adhering to the article having a parylene film.

14. The method of claim 13 wherein the step of providing an article having a parylene film comprises providing an article having a parylene film of up to about 1 mil.

15. The method of claim 13 wherein the step of providing a parylene coated article comprises providing a parylene coated fastener having a threaded portion.

16. The method of claim 13 wherein the step of applying a coating composition comprises electrodeposition of paint particles.

17. A method of attaching automotive assemblies comprising the steps of:

providing a fastener having a threaded portion;

coating the fastener with a parylene film;

inserting the fastener into an aperture of a first automotive assembly utilizing the threaded portion of the fastener;

electrocoating the automotive assembly and the fastener inserted therein with paint such that a continuous coating of paint is formed at the interface between the fastener and the automotive assembly;

preventing adhesion of the paint onto the exposed surfaces of the fastener having the parylene film; and

attaching a second automotive assembly to the first automotive assembly utilizing the fastener wherein the threaded portion of the fastener are substantially paint-free.

18. The method of claim 17 further including the steps of plating the fastener with a metal and providing a chromate conversion coating onto a surface of the fastener.

19. The method of claim 17 further including, after the step of preventing adhesion of the paint coating onto the parylene coated surfaces of the fastener, the step of phosphating metal surfaces of the automotive assembly.

20. The method of claim 19 further including, after the step of phosphating metal surfaces of the automotive assembly, the step of applying a primer to the phosphated metal surfaces.

21. A method of painting an automotive assembly comprising the steps of:

providing an automotive assembly including fasteners, the fastener having a parylene film of up to about 1 mil formed thereon;

electrocoating the automotive assembly with paint finish;

effectively preventing adhesion of the paint finish on the parylene film of the fastener such that subsequent contact with a part to be attached is unobstructed by excess paint.

22. A fastener having

a threaded portion; and

a parylene film formed on a surface of the fastener wherein subsequent coatings are effectively masked from adhering to the fastener surface.

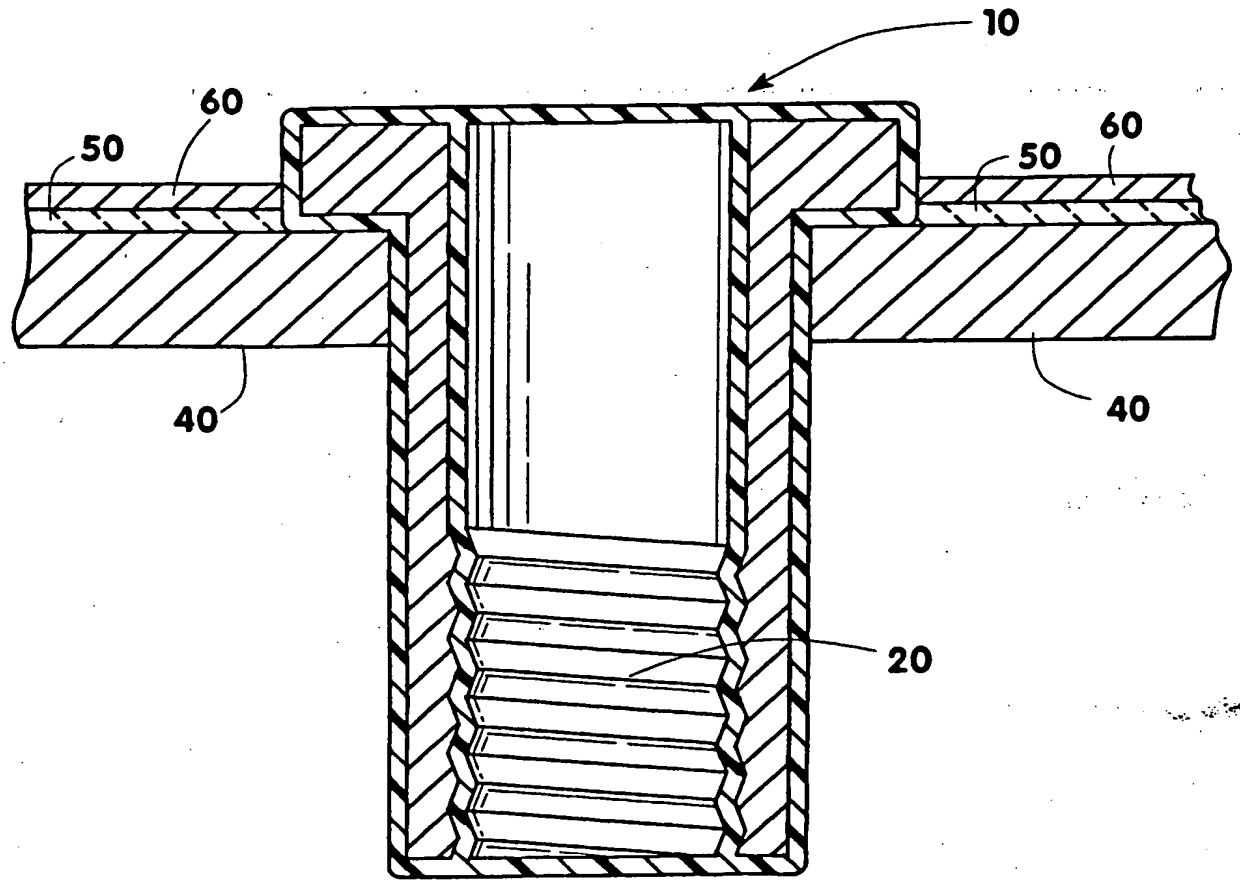
23. The fastener of claim 22 further including a metal plating selected from the group consisting of zinc, iron, nickel, copper, cadmium and alloys thereof.

24. The fastener of claim 22 further including a coating of a corrosion protection agent.

25. The fastener of claim 22 wherein the parylene film effectively masks subsequent electrodeposited coatings on the fastener surface such that re-tapping of the threaded portion is not required prior to use.

26. The fastener of claim 22 wherein the parylene film has a thickness of up to about 1 mil.

27. The fastener of claim 22 mounted in a panel coated with a layer of paint applied after mounting of the fastener, the parylene film preventing adhesion of the paint on surfaces of the fastener.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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US01/11007

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : B23P 25/00; C23C 28/00; C23D 13/00; B05D 5/00; F16B 35/04
US CL :29/458; 204/486; 427/282; 411/411
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 29/458, 428, 460, 525.01, 525.02, 525.11; 204/486, 471, 510, 485; 427/282; 411/411, 424, 427, 428, 436, 902, 903

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EAST

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5,356,255 A (TAKAHASHI et al.) 18 October 1998, see the whole document.	1-22, 25
Y	US 3,864,230 A (SPRINGER et al.) 04 February 1975, see the whole document.	1-21
Y	US 4,411,934 A (STEINHAGEN) 25 October 1983, see the whole document.	5, 11, 23, 24
Y	US 5,380,320 A (MORRIS) 10 January 1995, see the whole document.	6, 12, 14, 26
Y	US 4,856,954 A (PETERSON) 15 August 1989, see the whole document.	22, 24, 27
Y	US 5,685,680 A (DUFFY et al.) 11 November 1997, see the whole document.	22, 24, 27

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
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INTERNATIONAL SEARCH REPORT

International application No.
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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim N .
A	US 3,454,483 A (FREEMAN et al.) 08 July 1969.	
A	US 3,552,467 A (BERGERE) 05 January 1971.	
A	US 3,617,393 A (NAKAZAWA et al.) 02 November 1971.	
A	US 3,620,949 A (MORRISON et al.) 16 November 1971.	
A	US 3,954,588 A (HAZAN et al.) 04 May 1976.	
A	US 4,123,308 A (NOWLIN et al.) 31 October 1978.	
A	US 4,292,096 A (MURAKAMI et al.) 29 September 1981.	
A	US 4,389,260 A (HAUFFE et al.) 21 June 1983.	
A	US 4,401,053 A (RILEY) 30 August 1983.	
A	US 4,419,199 A (HAUFFE et al.) 06 December 1983.	
A	US 4,518,623 A (RILEY) 21 May 1985.	
A	US 4,673,444 A (SAITO et al.) 16 June 1987.	
A	US 4,835,819 A (DUFFY et al.) 06 June 1989.	
A	US 4,842,890 A (SESSA et al.) 27 June 1989.	
A	US 4,888,214 A (DUFFY et al.) 19 December 1989.	
A	US 4,960,050 A (HATCH) 02 October 1990.	
A	US 5,039,563 A (ENDO et al.) 13 August 1991.	
A	US 5,193,716 A (HORIKI et al.) 16 March 1993.	
A	US 5,221,170 A (DUFFY et al.) 22 June 1993.	
A	US 5,236,565 A (MULLER et al.) 17 August 1993.	
A	US 5,267,390 A (YANG et al.) 07 December 1993.	
A	US 5,270,082 A (LIN et al.) 14 December 1993.	
A	US 5,312,489 A (OLSON) 17 May 1994.	

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US01/11007

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5,571,323 A (DUFFY et al.) 05 November 1996.	
A	US 5,702,581 A (KERLIN et al.) 30 December 1997.	
A	US 5,707,505 A. (HUSS) 13 January 1998.	
A	US Re. 33,766 B1 (DUFFY et al.) 13 January 1998.	
A	US 5,714,047 A (PEDRAZZINI) 03 February 1998.	
A	US 5,851,371 A (STEINBRECHER et al.) 22 December 1998.	
A	US 5,879,808 A (WARY et al.) 09 March 1999.	